

SUBSIDENCE CONTROL PLAN
FOR
GENWAL COAL COMPANY, INC.



Submitted to
Mr. William C. Wollen, Vice President
GENWAL COAL COMPANY, INC.
Orangeville, Utah

By
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L. G. Manwaring
COAL SYSTEMS, INC.
Salt Lake City, Utah

August 28, 1981

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INTRODUCTION

The Subsidence Control Plan contained herein for Federal Coal leases Salt Lake 062648 and Salt Lake 050655 addresses specifically those items that are required by U.M.C. 784.20 of the "Regulations Pertaining to Surface Effects of Underground Coal Mining Activities (including regulations for coal exploration), Final Rules of the Utah Board and Division of Oil, Gas, and Mining," pages 91, 92, and 93.

This plan is an amendment to the original application filed on December 17, 1980, by Genwal Coal Company, Inc. The original application was submitted pursuant to the following: Title 40, Chapter 10, Utah Code annotated 1943, as amended, the "Cooperative Agreement between the United States Department of Interior and the State of Utah;" the Surface Mining Control and Reclamation Act (P.L. 95-87); and all regulations promulgated under those Acts affecting mining operation conducted in the State of Utah.

Since the original submittal, several operational and construction plans have been submitted in order that the mine operation satisfy regulatory compliance requirements.

MINING - GENERAL

History

The mine will be installed in an area of old works in the Hiawatha seam. Coal was produced from these operations during the period 1940 through 1955 and was sold locally for domestic coal.

Certain sections of the mine will be reopened so that water sump, ventilation, and coal haulage can be reestablished. Drawing 4047-1 illustrates the manner in which the old workings will be modified and repaired in order to bring them into compliance with modern regulations and the overall mining plans of Genwal Coal Company.

Where necessary, the workings will be widened to accommodate a 42-inch coal haulage conveyor, and proper supports will be placed in areas of questionable roof control.

The abandoned workings affect the placement of the upper seam entries. There is no way to monitor past subsidence from the old workings. Drawing 4047-2 indicates the preferred position of the intake, return, and conveyor entries.

Future Mining

The new mining operation currently being contemplated will access the Hiawatha and Blind Canyon Coal Seams by simply drifting in on the coal seams at the outcrop. The portal areas for both seams will have five entries: two ventilation intakes (and supplies), one coal haulage conveyor entry, and two ventilation returns. The portal access area for each mine will have the necessary surface support items such as fans and conveyor drives.

The following describes the general sequence of mining both the Hiawatha (lower) and the Blind Canyon (upper) coal seams. It should be clearly understood that the upper seam will be second mined before the lower seam; however, the lower seam will be developed first. The lower seam will develop faster than the upper seam because it is thinner (6-foot versus 9-foot) but economics and quality of coal justify what appears to be reversed logic in developing the lower seam first but second mining it last.

The mining plans for the Upper and Lower Hiawatha Coal Seams are illustrated in Drawings 4047-1 and 4047-2 respectively. The seams will be developed in the following sequence:

<u>LOWER SEAM</u>	<u>UPPER SEAM</u>
1. Portal area excavated	-----
2. Actual portals established	1. Portal area excavated
3. Permanent fan installed for ventilation	2. Actual portals established
4. North Mains started	3. Permanent fan installed for ventilation
5. North Mains completed to intersection of West Mains	4. North Mains started
6. West Mains started	5. North Mains completed to intersection of West Mains
7. West Mains completed	6. West Mains started
8. Development of Panel "B" started	7. West Mains completed
9. Development of Panel "B" completed	8. Development of Panel "A" started
10. Development of Panel "A" started	9. Development of Panel "A" completed
11. Development of Panel "A" completed	10. Second mining started in Panel "A"
12. Second mining started in Panel "A"	11. Second mining completed in Panel "A"
13. Second mining completed in Panel "A"	12. Panel "A" sealed
14. Panel "A" sealed	13. Development of Panel "B" started
-----	14. Development of Panel "B" completed
-----	15. Second mining started in Panel "B"
15. Second mining started in Panel "B"	16. Second mining completed in Panel "B"

- | | |
|---|---|
| 16. Second mining completed in Panel "B" | 17. Panel "B" sealed |
| 17. Panel "B" sealed | 18. Second mining of West Mains started |
| 18. Second mining of West Mains started | 19. Second mining of barrier pillars for West Mains started |
| 19. Second mining of barrier pillars for West Mains started | 20. Second mining of West Mains & barrier pillars completed to Panel "C" intake |
| 20. Second mining of West Mains & barrier pillars completed to Panel "C" intake | 21. Development for Panel "C" started |
| 21. Development for Panel "C" started | 22. Development for Panel "C" completed |
| 22. Development for Panel "C" completed | 23. Second mining for Panel "C" started |
| 23. Second mining for Panel "C" started | 24. Second mining for Panel "C" completed |
| 24. Second mining for Panel "C" | 25. Panel "C" sealed |
| 25. Panel "C" sealed | 26. Second mining for West Mains continued |
| 26. Second mining for West Mains continued | 27. Second mining for barrier pillars for West Mains continued |
| 27. Second mining for barrier pillars for West Mains continued | 28. Second mining for North Mains & barrier pillars started & completed |
| 28. Second mining for North Mains & barrier pillars started & completed | 29. Portal sealed |
| 29. Portal sealed | ----- |

Pillar Recovery Plan

The proposed pillar recovery plan is preferred because of a safety feature it offers, i.e. the mechanical miner operator will have a solid rib of coal on his right at all times as the actual mining takes place.

In this scheme the 80' x 80' pillar of coal is divided into three sections of 15' x 80'. This is accomplished by cutting two 17'-wide rooms through the pillar (see following Sheets 1 and 2). Roof jacks are used as temporary supports and require that roof bolting advance as the mechanical miner advances. Bolting may be alternated between the first and second rooms as the miner advances the prescribed distance in each cut.

Once the rooms are completed, six timbers are set in each room next to the cave line. These timbers become the breaker rows in the caving process (see Sheet 2). The radius rows of timber are then set at the prescribed distance, and ventilation set for the mining of Fender "A" (see Sheets 3 and 4).

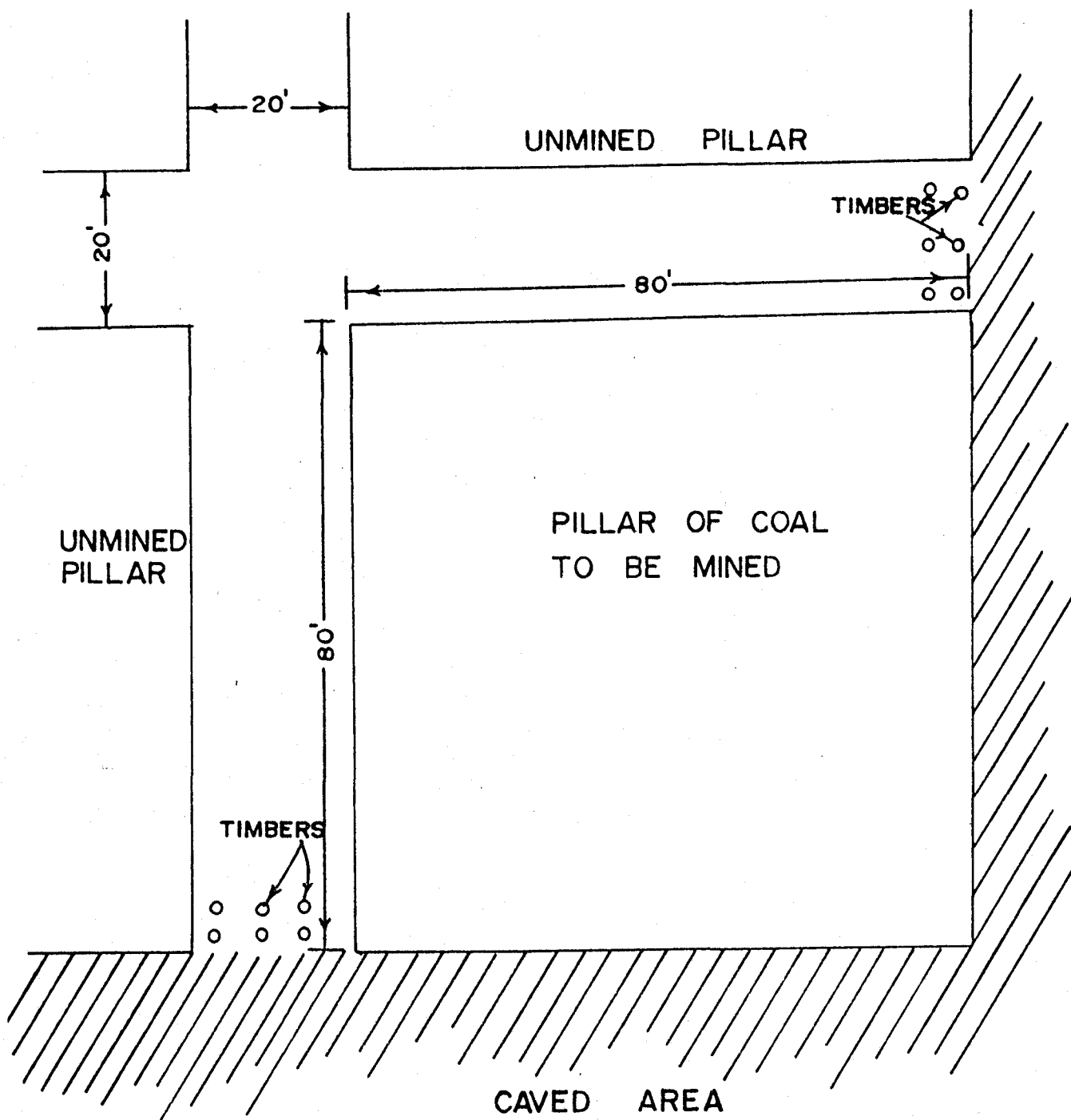
After all safety precautions are established, actual mining of Fender "A" can begin. Approximately nine diagonal cuts are made through the fender making certain the operator remains under secured roof and adequate ventilation is established to move the dust and methane into the caved area (see Sheets 4 and 5).

Caving can be expected at any time or place and all personnel must remain alert to the various signs of premature caving. However, controlled caving should begin when the pillar has been removed and all personnel are well clear of the area (see Sheet 5).

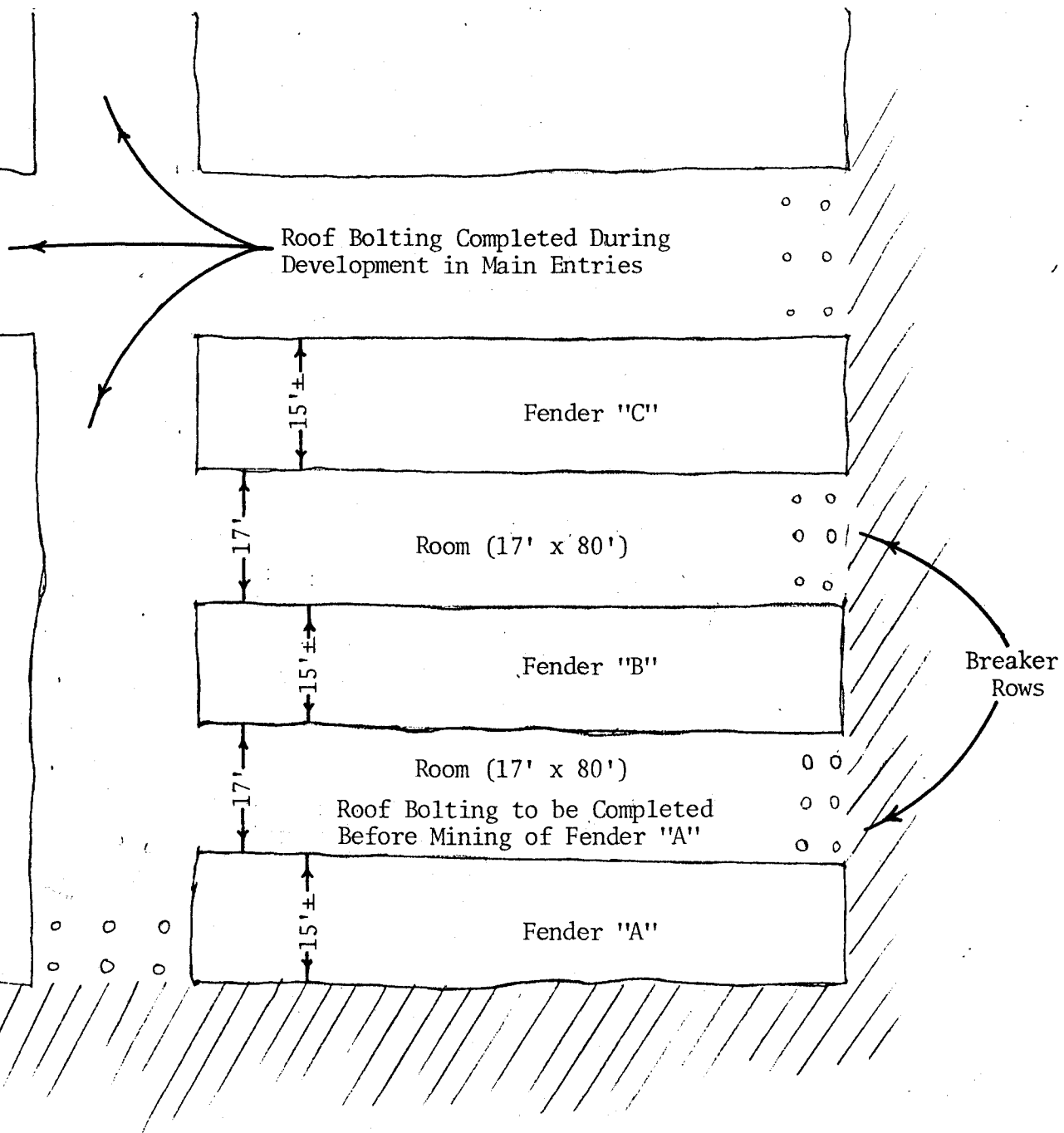
The cut sequence used to extract coal from Fender "A" will be identical for Fenders "B" and "C".

Sequence of Pillar Recovery

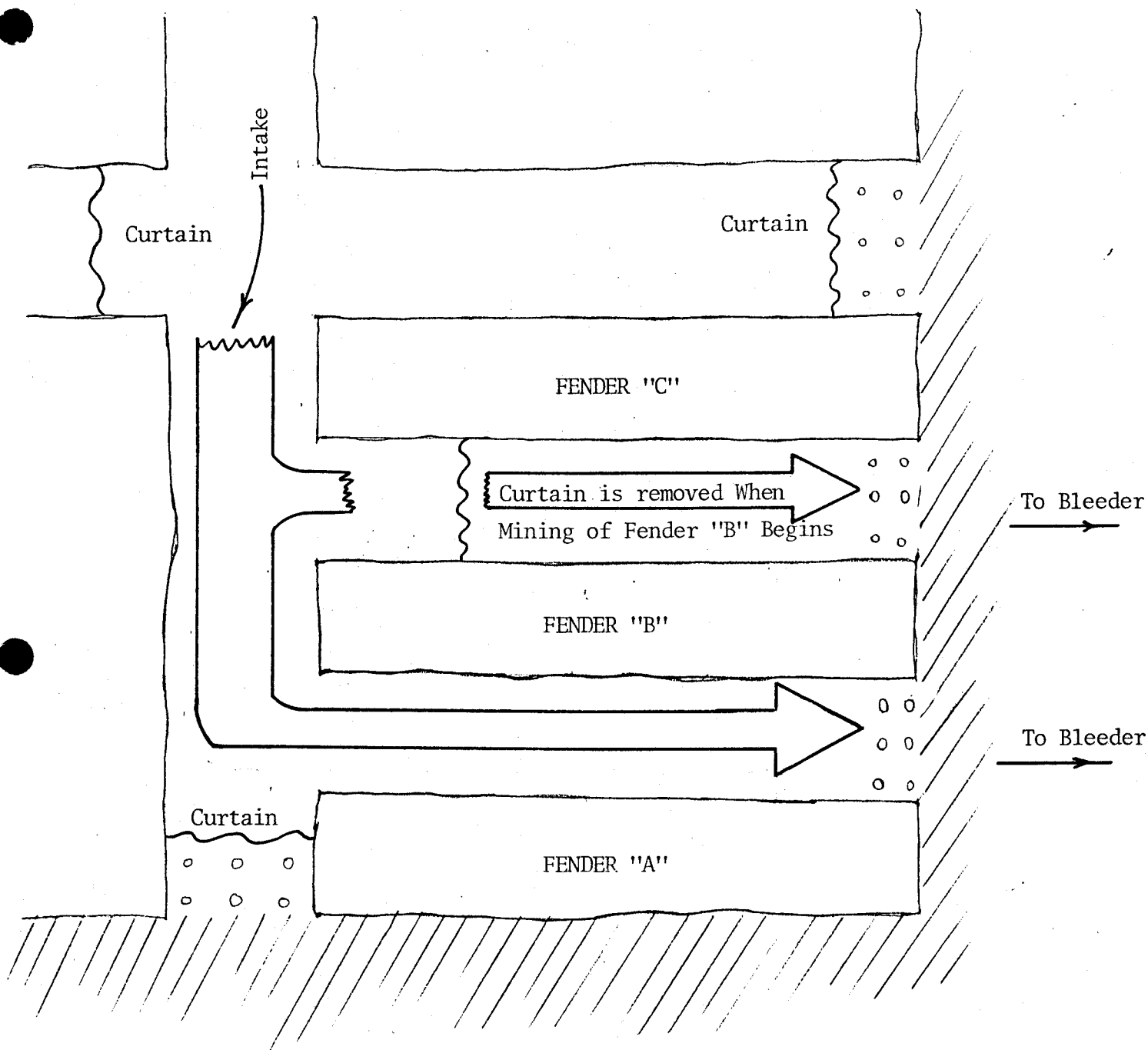
Sheet 7 indicates the sequence in which the remaining pillars will be extracted. Past experience indicates this method will recover between 60 and 70 percent of the coal within a panel area. If bleeder support pillars are left for ventilating the panel, this will move the recovery factor closer to 60 percent.



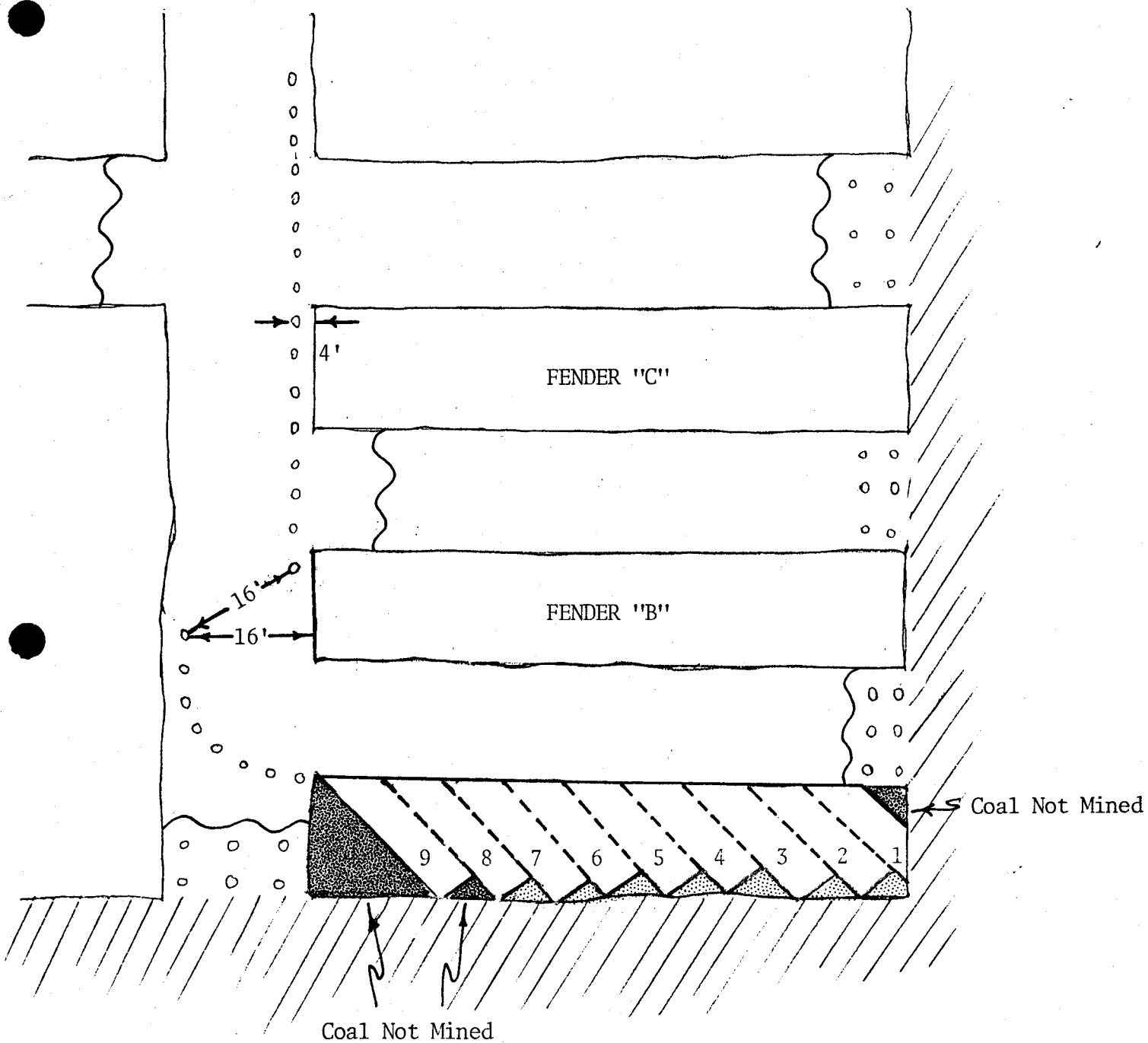
UNMINED PILLAR



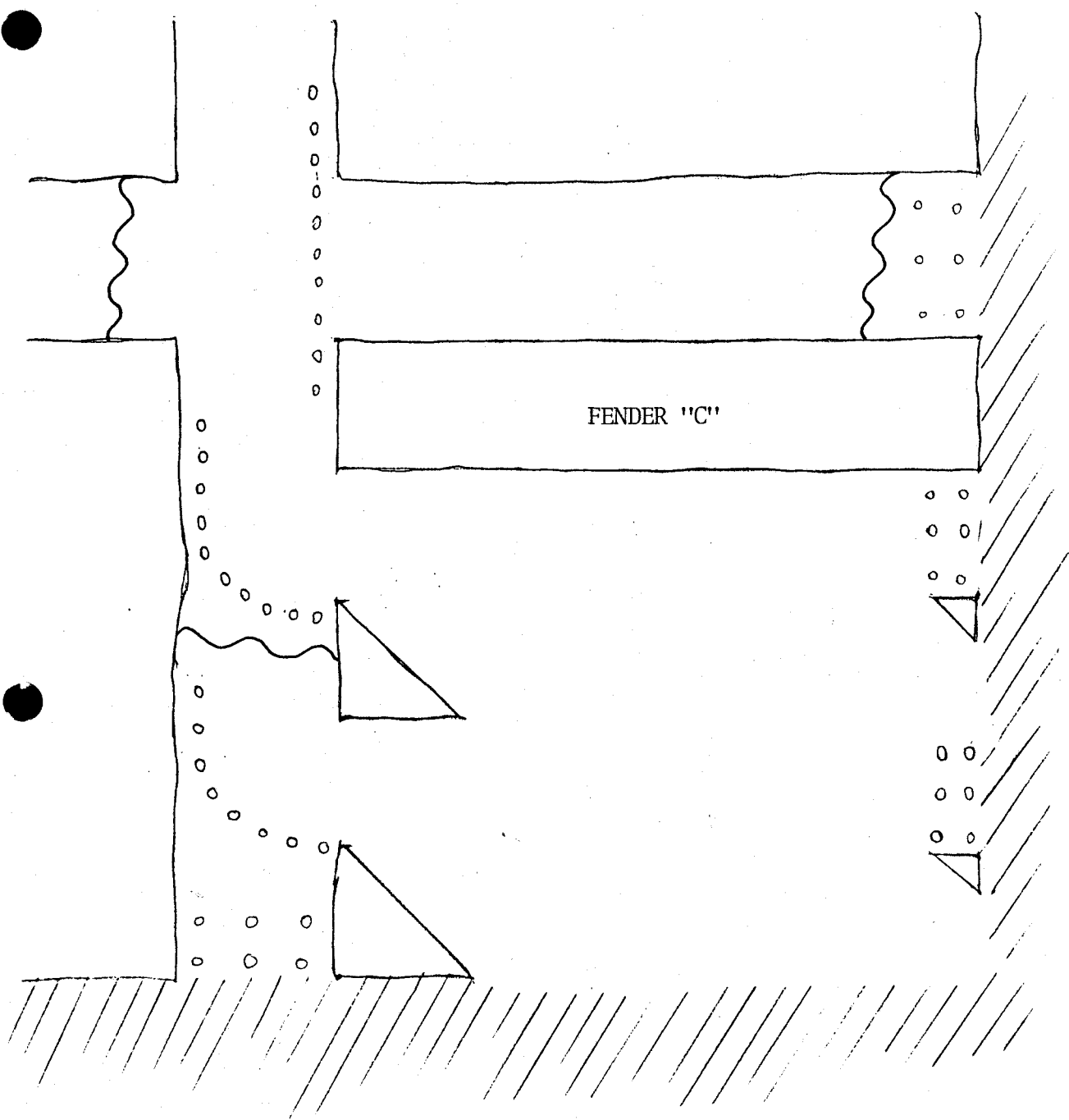
17' x 80' ROOMS COMPLETED



Ventilation of Rooms Prior to Mining of Fenders



FENDER 'A' MINING SEQUENCE

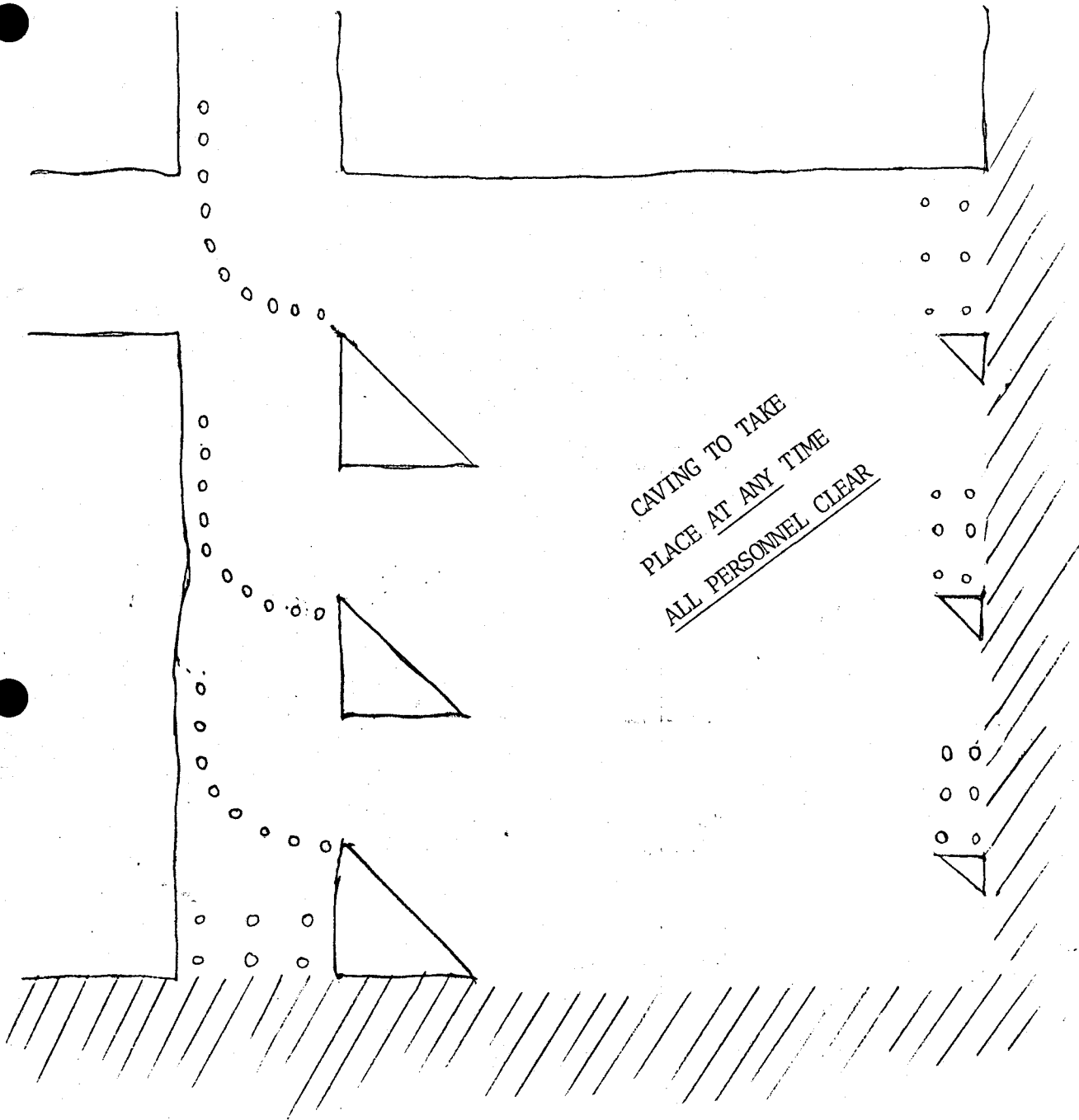


Fender "B" Mining Completed

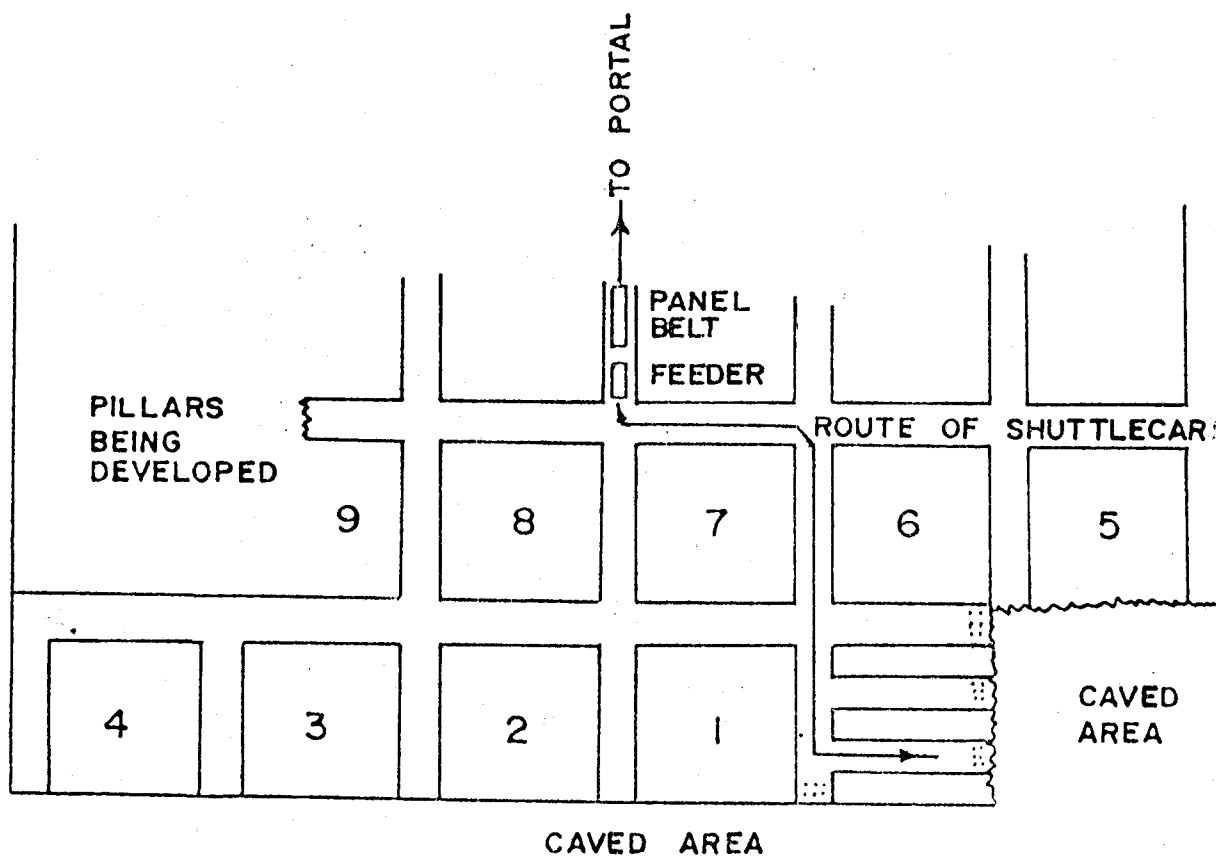
BY DAS DATE 7-29-81
CHKD. BY LGM DATE

SUBJECT Pillar Recovery Plan

SHEET NO. 6 OF
JOB NO.



FENDER "C" MINING COMPLETED



SEQUENCE IN WHICH EACH PILLAR WILL BE EXTRACTED

SUBSIDENCE CONTROL PLAN

Geology

The coal beds to be mined on the Genwal leases occur in the lower part of the Blackhawk Formation. The Formation is comprised of approximately 1,000 feet of gray carbonaceous shales, siltstones, coals and thin interbedded sandstones of late Cretaceous Age. The Star Point Sandstone, a massive cliff-forming 700 to 900-foot thick sandstone unit, underlies the Blackhawk formation and its top serves as a useful lithologic landmark in the area.

The formations in the area dip gently (1-3 degrees) westward off the west flank of the San Rafael Swell. The regional structure attitude is broken by several north-south trending, high-angle normal faults which offset the rocks from less than 10 feet to 250 feet or more.

The coal seams to be mined are the Hiawatha seam (approximate thickness 6 feet) and the Blind Canyon seam (approximate thickness 9 feet). Coal from both of these seams within the permit area is a high volatile bituminous type. The Hiawatha will be entered from an elevation of 7,885 feet and the Blind Canyon from an elevation of 7,950 feet. The 60 feet of Blackhawk Formation which separates the two seams of coal is typically carbonaceous shale, siltstones, and thin interbedded sandstones, all varying from 6 inches to 4 feet or more in thickness. The old works in the Hiawatha Seams are accessible and it appears that the immediate roof layer is a competent sandstone (laminated to massive) interrupted by an occasional shale-siltstone lens varying in thickness from approximately 6 inches to 2 feet. Falls of roof in the old works are confined to the siltstone lenses and where observed are usually at intersections of rooms and entries. Falls, where observed, are generally over the width of the opening, that is, they extend rib to rib.

The immediate roof in the Blind Canyon seam as observed from the outcrop appears to be of similar type rock, but about 25% less competent due to a higher shale content.

The floor of both coal seams grades from a clayey shale, 1-foot to 3-feet thick, to a laminated sandstone, as observed in the old Hiawatha works and outcrop in the Blind Canyon.

Overburden

Generally speaking, the term "subsidence" applies to the deformation or movement in the overburden two or more mine entry heights above the immediate mine roof. In this case the thickness of overburden ranges from outcrop to over 1,000 feet. The strength of the overburden is typical of the late Cretaceous sediments that are mined in Eastern Utah and Western Colorado.

It is accepted practice in this area to use two sources of information for subsidence evaluation. The sources are: 1) "Some Engineering Geologic Factors Controlling Coal Mine Subsidence in Utah and Colorado," Geological Survey Professional Paper 969, by C. Richard Dunrud, 1976, and 2) "SME Mining Engineering Handbook, Volume 1," Arthur B. Cummins and Ivan A. Given, 1973.

The conclusions based on the above sources are also tempered by some on-site review, and actual experience based on similar mining conditions in late Cretaceous overburdens with similar thicknesses and strengths.

Regarding those surface areas within the leases, the topographic map Drawing 4047-3 indicates the relatively steep sloping sides of Crandall Canyon which contain Crandall Canyon Creek. There is little or no talus slope and rock outcrops are abundant.

Surface Features

The Statement of Fact in the Appendix confirms there are no man-made structures inside the property boundary that would require subsidence control planning. The accompanying photo and maps of the area also confirm Mr. Wollen's conclusions.

Furthermore, there appears to be no springs or creeks on the proposed permit area; however, Crandall Creek is located within 200 feet horizontally and about 300 feet vertically from the boundary line of the property. Drawing 4047-3 indicates the relative position of Crandall Creek to the lease boundary. Additional discussion is required to satisfy questions raised by this relationship.

Calculations indicate that subsidence might occur as close as 60 feet from the center line of the creek if mining is allowed to extract both seams of coal from the lease allowing for only 50 feet of barrier pillar along the southern boundary immediately adjacent to Crandall Creek.

It is recommended that in order to protect the integrity of Crandall Creek, an additional 150 feet of barrier pillar be left in place (200 feet total). In addition to the increased barrier pillar, the developed coal between the barrier pillar and a 350-foot radius from the southwest corner of the property will be restricted to a mining recovery of 50%. The size and shape of pillars in this area are illustrated on Sheets 8 and 9.

Currently, there are no plans to backfill any area of the mine with waste material in order to reduce subsidence.

Calculations

The main objectives of this plan are to delineate the areas of the lease and adjacent land that will be affected by subsidence and to determine the extent of the disturbance.

Significant guiding criteria are as follows:

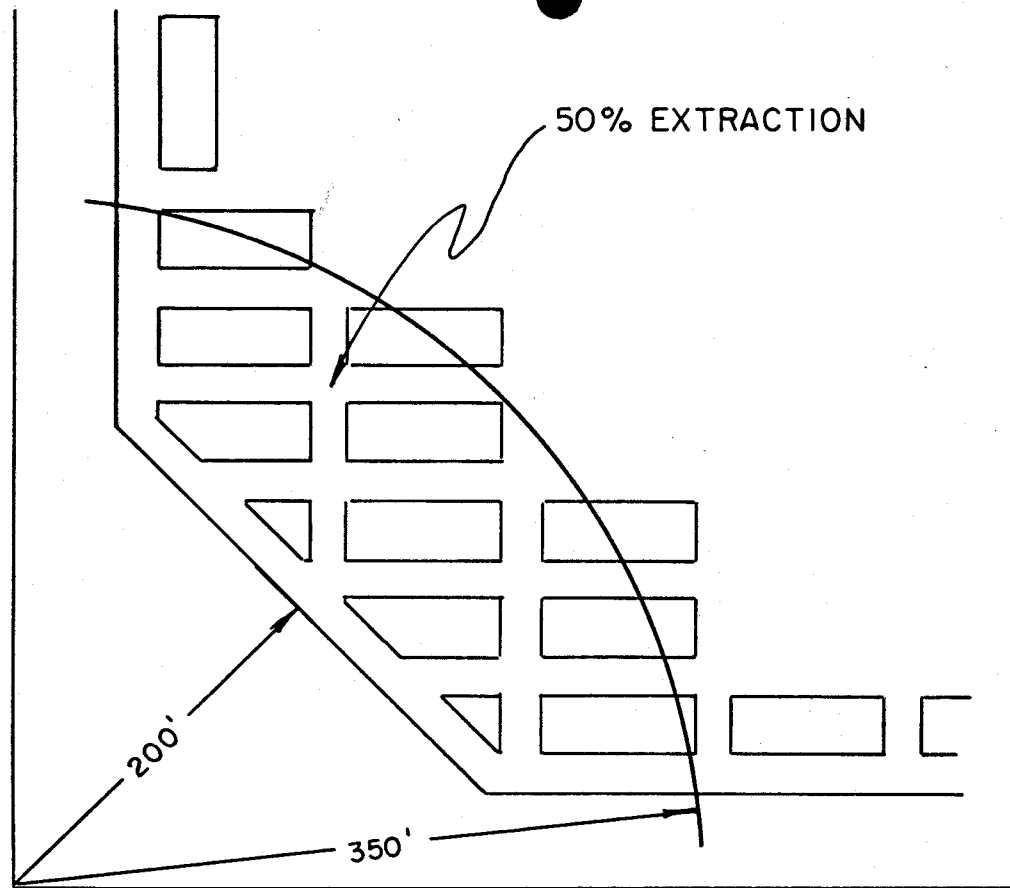
- o A 50-foot barrier pillar will be maintained on the lease directly adjoining the boundary; the exception to this case is the southwest corner of the property where the barrier pillar has been extended to 200 feet.
- o Research indicates that a 30 degree positive limit "draw angle" should be used to project maximum extent of subsidence in the Eastern Utah/Western Colorado coal mining region (see Sheet 10).
- o Most areas will be affected by the worst case in which a total of 15 feet of coal will be mined from the two seams.

Southwest Corner - Tangent 30° x 350 feet of overburden = 202.1 feet.

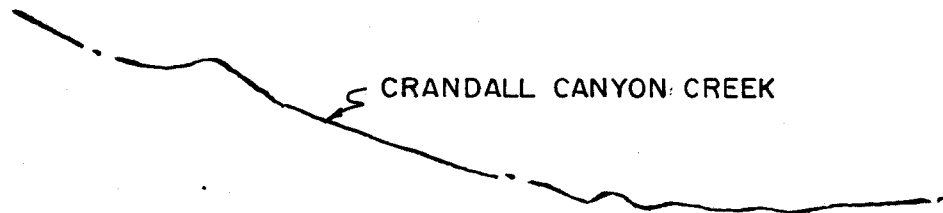
As previously noted, this corner is within 200 feet of the center line of Crandall Creek; the decision to increase the boundary barrier pillar to 200 feet moves the permit boundary back to within the lease area (see Sheet 11).

Northwest Corner - Tangent 30° x 1,050 feet of overburden = 606.2 feet (use 600 feet).

A radius of 600 feet from the northwest corner was used to inscribe an arc which defines the permit boundary.



-16-



GENWAL COAL COMPANY, INC.

SCALE: 1" = 100'

APPROVED BY:

DRAWN BY I.L.

DATE: 8-29-81

D. A. S.

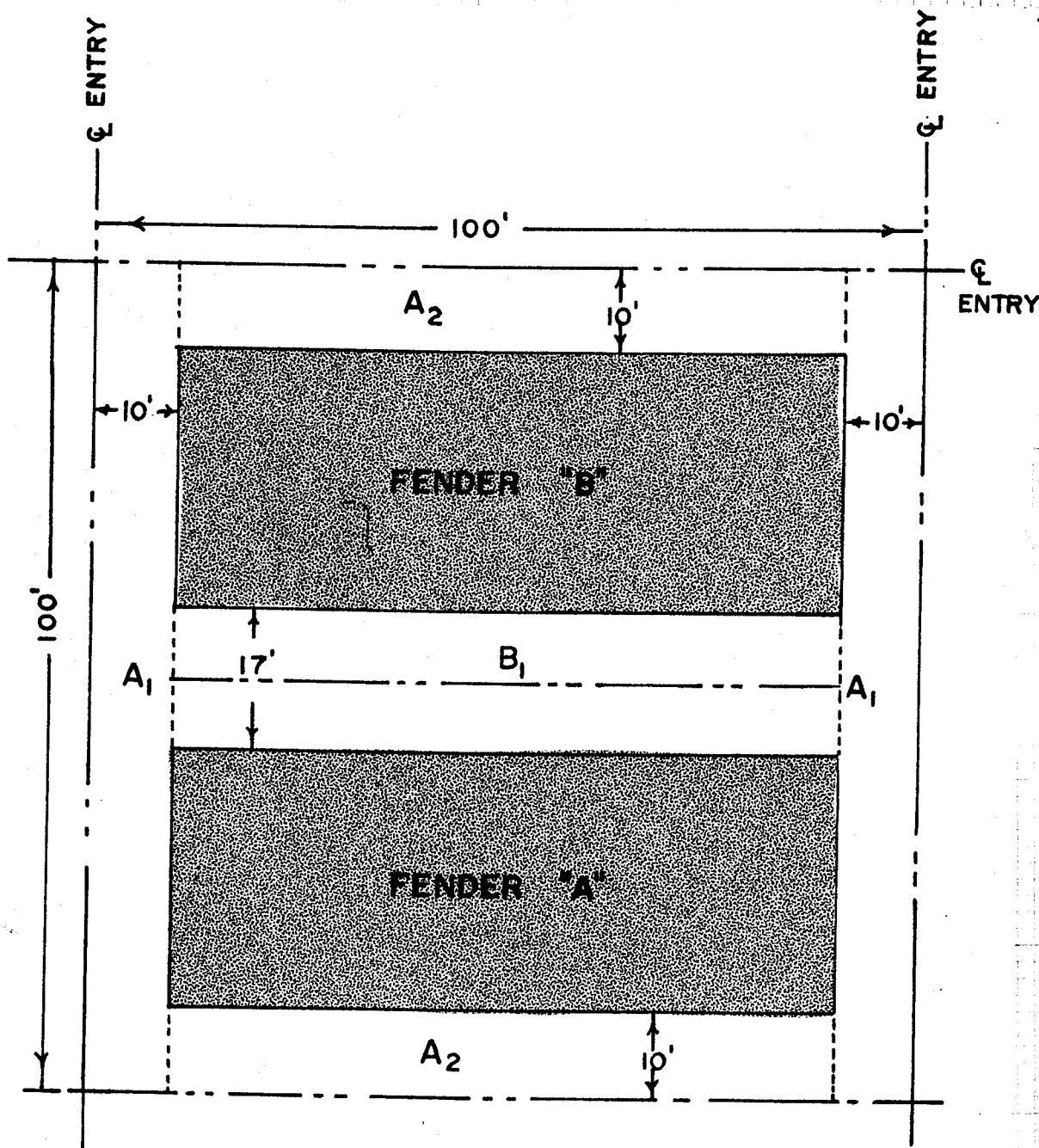
REVISED

DETAIL OF SOUTHWEST CORNER — 50 % EXTRACTION

COAL SYSTEMS, INC.

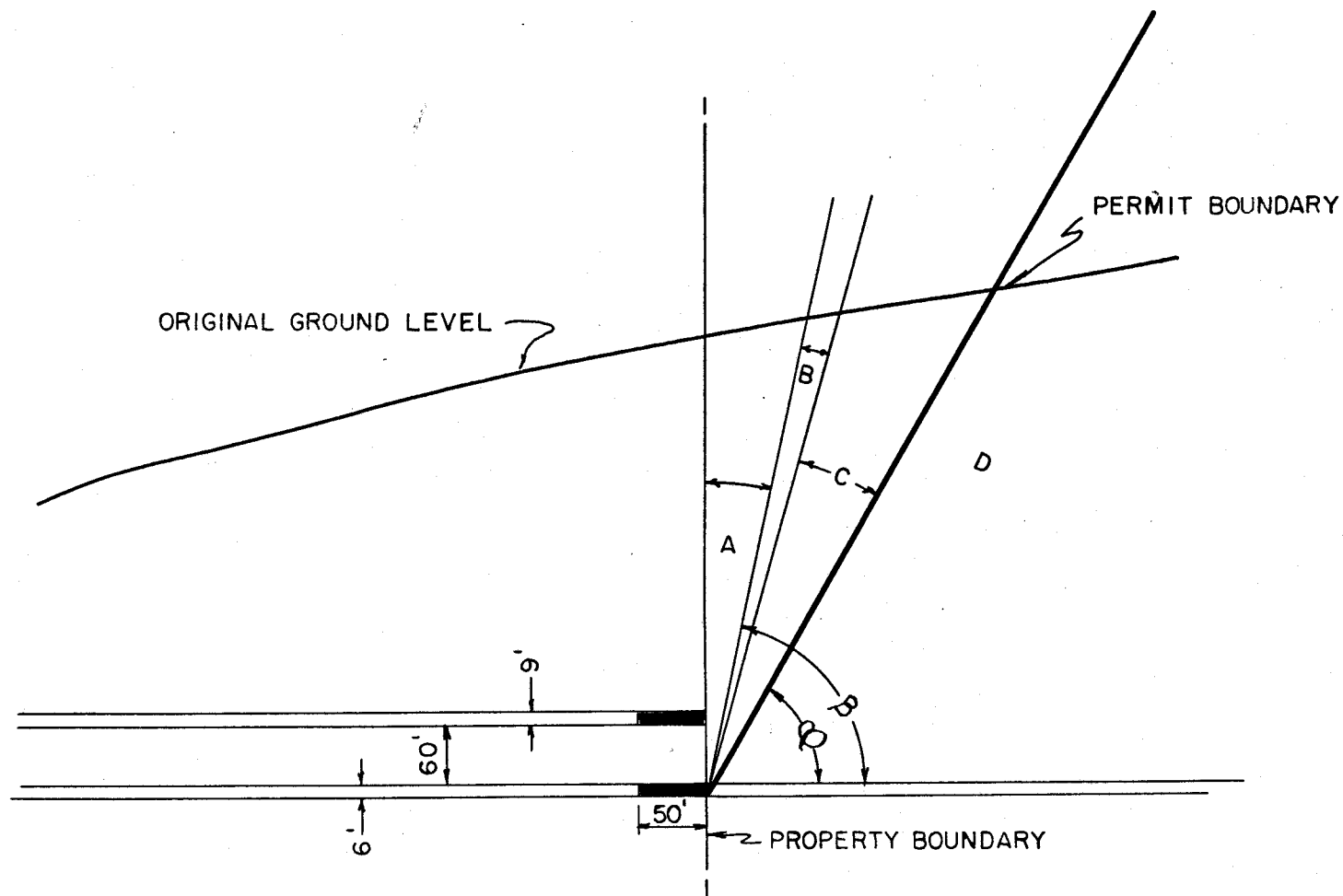
DRAWING NUMBER

SHEET NO. 8



AREA (FT. ²)	% OF TOTAL AREA
A ₁ = 2000	20
A ₂ = 1600	16
B ₁ = 1360	14
	<u>50%</u>

TYPICAL 50% RECOVERY PLAN FOR 80' x 80' PILLAR



GENWAL COAL COMPANY, INC.

SCALE:

APPROVED BY:

DRAWN BY I. L.

DATE: 8-29-81

D. A. S.

REVISED

TYPICAL CROSS SECTION
BASIS FOR PERMIT CONFIGURATION

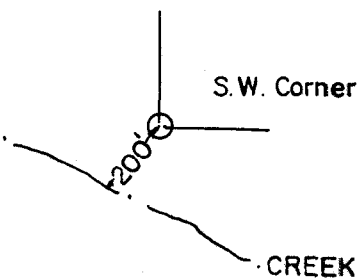
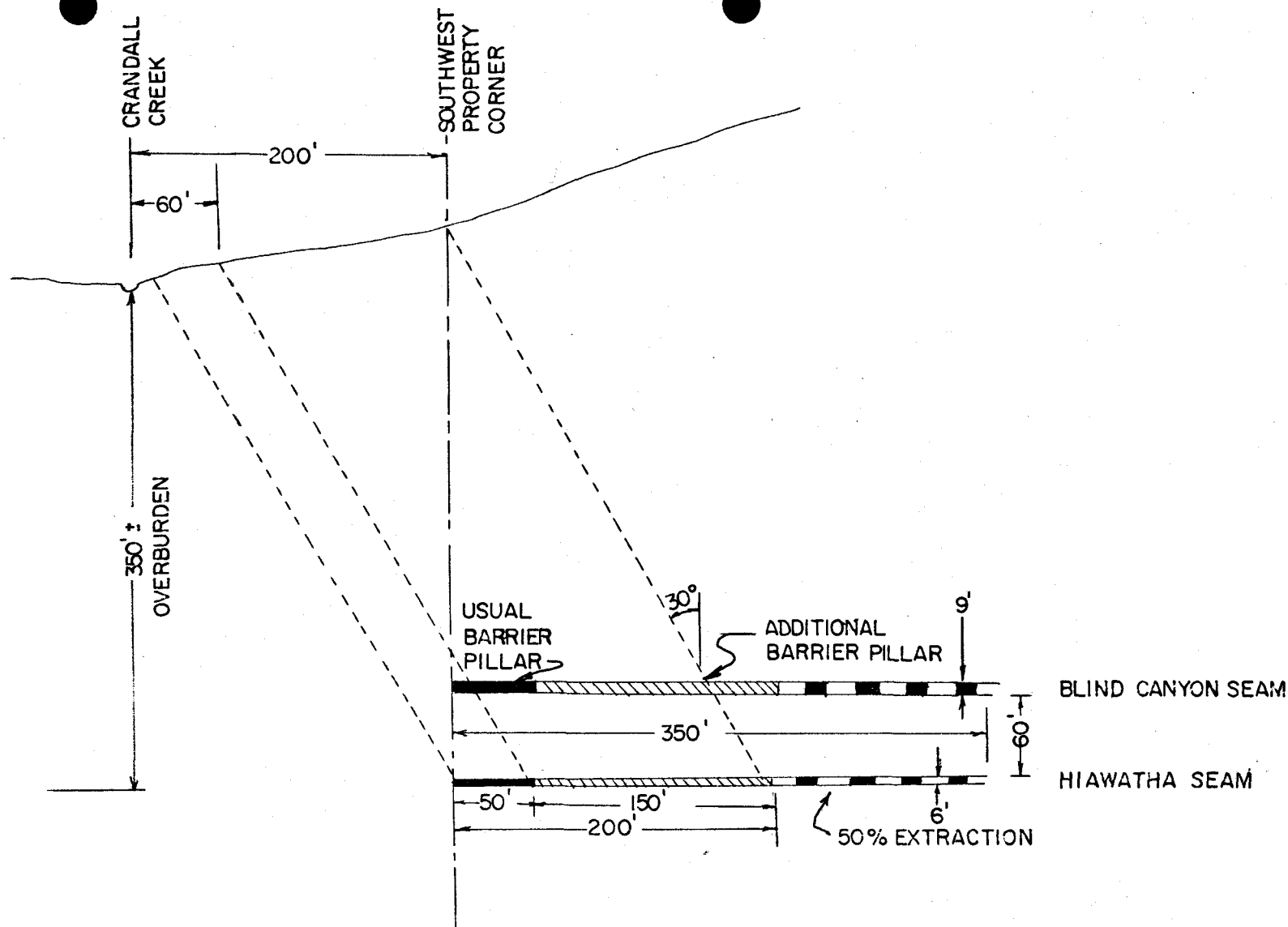
COAL SYSTEMS, INC.

DRAWING NUMBER
SHEET NO. 10

- A. This angle is the reciprocal of the break line angle (B) of 78°. This angle also corresponds to the plan view in Drawing 4047-4 and is also represented in that drawing by the letter "A".^{1/}
- B. Angle "B" represents the maximum break line found at the Geneva Mine, Utah.^{1/} It is felt that some form of deformation will take place in this area. Drawing 4047-4 also indicates this area with the letter "B".
- C. Angle "C" represents that area where light to moderate subsidence will be experienced. This also represents the expected extent of the subsidence. This angle is also called the Positive Limit (or Draw) Angle (ϕ). Drawing 4047-4 denotes this area with the letter "C" and is part of the permit area.
- D. This area is outside the permit boundary where little or no subsidence is planned.

^{1/} U.S.G.S. Professional Paper 969, pages 4 and 34.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
		DRAWING NUMBER SHEET NO. 10-A



GENWAL COAL COMPANY, INC.

SCALE: 1" = 100'

APPROVED BY:

DRAWN BY I.L.

DATE: 8-29-81

D. A. S.

REVISED

DIAGRAM OF ADDITIONAL BARRIER PILLAR

COAL SYSTEMS, INC.

DRAWING NUMBER

SHEET NO. 11

Northeast Corner - Tangent 30° x 700 feet of overburden = 404.15 feet (use 400 feet).

A radius of 400 feet from the northeast corner was used to inscribe an arc which defines the permit boundary.

Southeast Corner - The coal outcrops near this corner, but for simplicity sake, the boundary was extended to this corner and made to follow the south boundary line of the lease to the $W\frac{1}{4}$ corner of Section 5. Here again the overburden increases sufficiently to extend the permit area beyond the lease boundary.

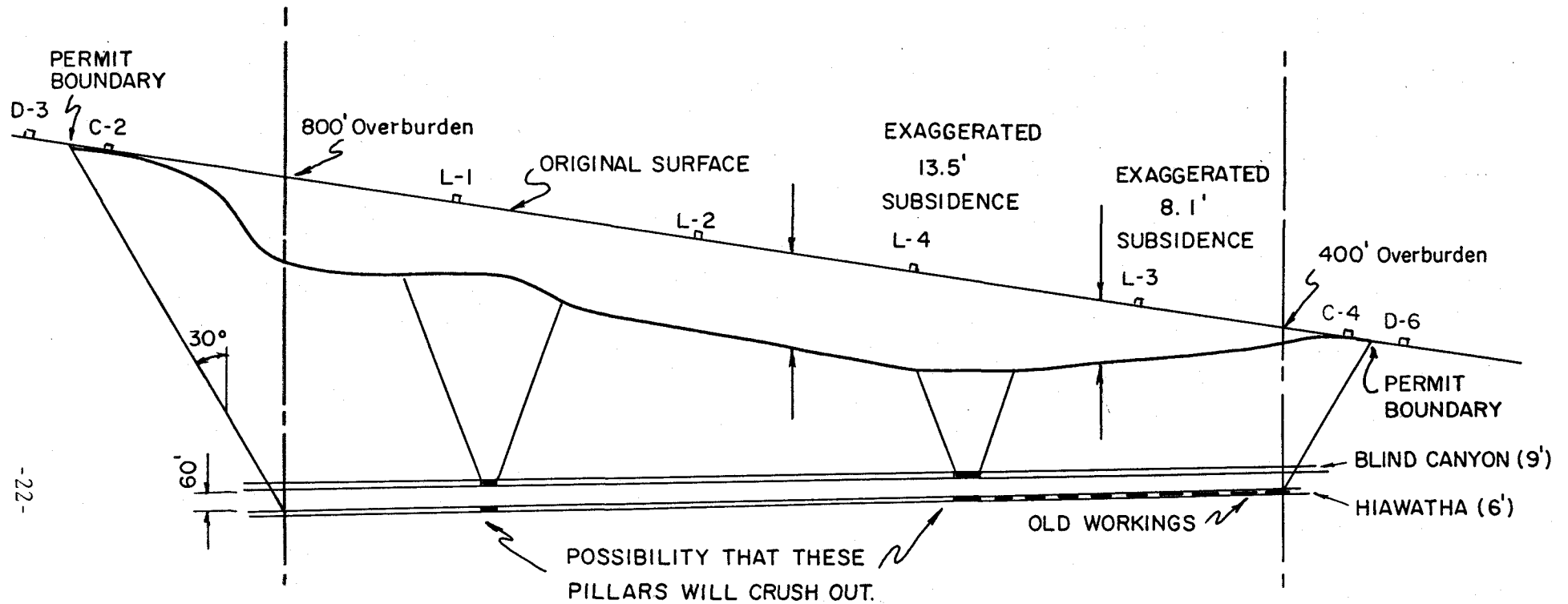
West $\frac{1}{4}$ Corner of Section 5 - Tangent 30° x 200 feet of overburden = 115.5 feet (use 120 feet).

The boundary was extended to the $W\frac{1}{4}$ corner and turned westerly to another point, calculated in a similar manner, located 350 feet east of the southwest corner (the Point of Beginning). This point is the limit established for 50% extraction in order to protect Crandall Creek.

Radius Point of 50% Extraction Limits - Tangent 30° x 300 feet of overburden = 173.2 feet (use 175 feet).

Amount of Subsidence - Maximum surface subsidence anticipated will amount to approximately 90% of the combined thickness of the two seams. Areas of maximum subsidence are expected in the $SE\frac{1}{4}$ $NE\frac{1}{4}$ Section 6 ($6' + 9' \times 0.90 = 13.5'$) and in the $SW\frac{1}{4}$ $NW\frac{1}{4}$ Section 5 ($9' \times 0.90 = 8.1'$) (see Sheet 12).

CROSS SECTION A-A



GENWAL COAL COMPANY, INC.

SCALE:

APPROVED BY:

DRAWN BY I. L.

DATE: 8-29-81

D. A. S.

REVISED

EXAGGERATED CROSS SECTION
SHOWING PLANNED SUBSIDENCE

COAL SYSTEMS, INC.

DRAWING NUMBER
SHEET NO. 12

DESCRIPTION OF PERMIT AREA

Drawing 4047-4 was constructed from the previous calculations in order to depict the resulting conclusions and hence the location of the permit boundary.

Drawing 4047-4 indicates that the largest magnitude of subsidence will occur inside the lease area in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ of Section 6; subsidence of up to 13.5 feet is anticipated.

Subsidence in the eastern portion of the lease (SW $\frac{1}{4}$ NW $\frac{1}{4}$ Section 5) may be less due to the possible inability to conduct full-scale second mining of the old works (see Sheet 12).

The unusual configuration of the permit boundary outside of the lease boundary is the result of calculations based on the thickness of both seams of coal to be mined and the depth of overburden at the lease boundary. Note the larger radius of the permit boundary in the northwest corner of the property as compared to the smaller radius in the northeast corner of the property. This is due to the thicker overburden in the northwest area.

The legal descriptions of Federal Leases Salt Lake 062648 and Salt Lake 050655 are the SW $\frac{1}{4}$ NW $\frac{1}{4}$ Section 5 and SE $\frac{1}{4}$ NE $\frac{1}{4}$ Section 6, Township 16 South, and Range 7 East of the Salt Lake Base Meridian encompassing 80 acres more or less.

The description of the permit area is as follows:

"The southwest corner of the lease is the Point of Beginning; thence northerly 1,220 feet more or less to the intersection of a 600-foot arc whose center is the northwest corner of the lease; thence easterly 2,680 feet more or less to the intersection of a 400-foot arc whose center is the northeast corner of the lease; thence southerly 1,250 feet to the southeast corner of the lease; thence 1,320 feet westerly more or less to the W $\frac{1}{2}$ corner of Section 5; thence due south 120 feet; thence westerly 971 feet more or less; thence due north 175 feet to the southern boundary of the lease (SE $\frac{1}{4}$ NE $\frac{1}{4}$ Section 6); thence to the Point of Beginning; encompassing 139 acres more or less (by planimeter)."

Drawing 4047-4 indicates the approximate location of each subsidence monitoring monument (or station). Those monuments designated with the letter "D" are to be placed outside of the projected disturbed areas and therefore will be unaffected by any subsidence. These monuments may also be used as the datum monuments for the other monuments.

Those monuments prefixed with the letter "C" should show slight indications of subsidence. These movements may be relatively small (i.e. $\pm 15\% \times 12 \text{ feet} = 1.3 \text{ feet}$).

Those monuments with "L" for "Lease" will be the indicators of rapid subsidence in areas of 400 feet to 800 feet of overburden. Movement at those stations should be noticed within two or three months after caving begins in each seam. This time may be reduced if the overburden is thinner and increased if thicker.

The monitoring sequence should begin with those monuments designated "L" as soon as retreat or second mining begins in the upper seam and should be monitored at no less than three week intervals until movement is detected and recorded. Thereafter, monitoring every quarter (three months) should be sufficient. After the second quarter (six months), monitoring should begin on all "C" stations within the panel's immediate vicinity. Once mining has been completed or there is no longer any indication of horizontal or vertical movement in the "C" or "L" series of stations, the monitoring of the "D" stations should begin, and should be continued until it can be determined with certainty that no further movement will occur.

As the upper seam is mined, subsidence will occur to a maximum of 8.1 feet near the center of each panel. The ground will routinely stop subsiding until mining of the lower seam is started; a second drop of 4.5 feet (maximum) may then be expected. Care should be taken not to mistake a "lull" in the subsidence as a final and conclusive movement.

As the mining plan is developed and before the retreat mining is to begin, the monuments should be placed in the proper position as recommended in this plan. The following information should then be forwarded to the proper authority:

- o A complete list of monuments with beginning horizontal and vertical coordinates.

- o A current map of the underground workings with areas delineated as to where the second mining will begin.

- o The date when second mining will commence and terminate.

As the second mining proceeds, further information will be forwarded indicating those stations in which movement was first detected and the amount of movement.

As the second mining terminates, information will be forwarded when subsidence ceased and noting the total net drop.

APPENDICES

AND

MAPS

STATEMENT OF FACT

I, WILLIAM C. WOLLEN of P.O. Box 38, Orangeville, Utah do hereby declare that I am an interested party in the Federal Leases Numbers Salt Lake 062648 and Salt Lake 050655.

I have recently made a surface reconnaissance (survey) of the above subject area and can report that there are no surface utility right-of-ways or easements currently crossing the affected portion of property. Furthermore, I can state there are no dwelling or structures occupied or unoccupied that would be affected by future mining activities. In addition to the surface survey, I have reviewed state, federal, and county records in regards to any future construction of public utilities right-of-ways or easements in the future and have determined there are none planned in the subject area.

The surface reconnaissance (survey) shows that no structures exist, and no material damage or diminution could be caused in the event of mine subsidence.

In addition to the above statement, I am supplying the attached air photo (Exhibit A) of the subject area.

This statement being sworn to on this ____ day of September 1981.

William C. Wollen

STATE OF UTAH)
) ss.
 COUNTY OF _____)

SUBSCRIBED AND SWORN TO BEFORE ME THIS ____ DAY OF SEPTEMBER, 1981,
 BY WILLIAM C. WOLLEN.

WITNESS MY HAND AND OFFICIAL SEAL.

NOTARY PUBLIC

COMMISSION EXPIRES

JUNE 4, 1980

0045

1-06

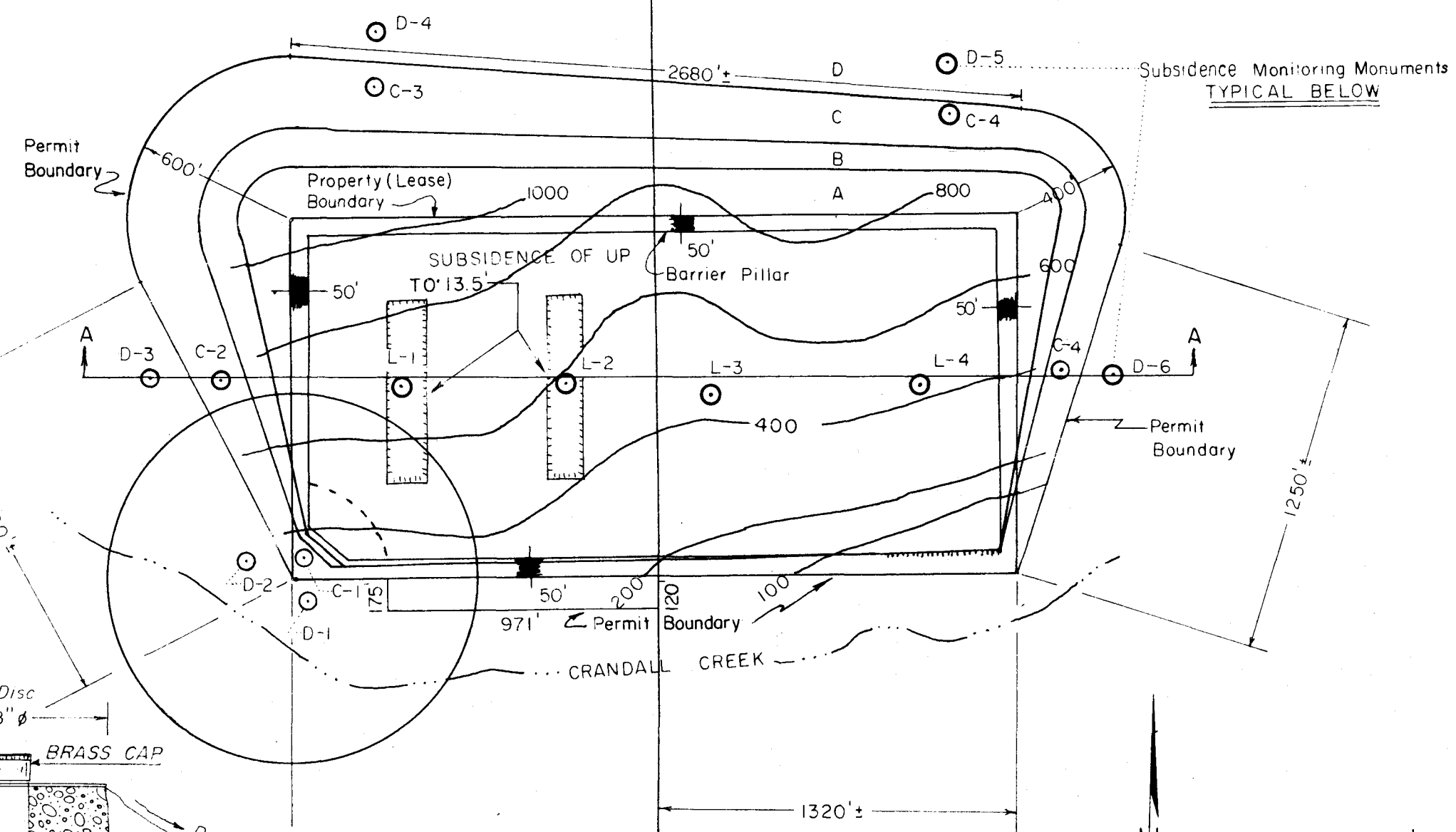


EXHIBIT A

Circle represents the general area that the surface survey covered-Crandell Creek is the main creek generally trending east-west.

NOTE: Permit Area=139 Acres
By Planimeter

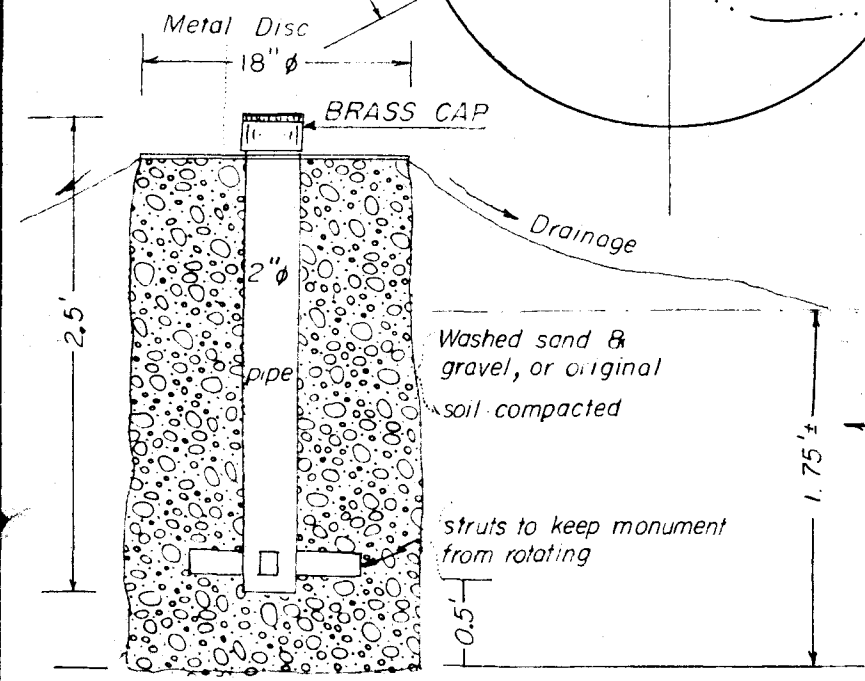
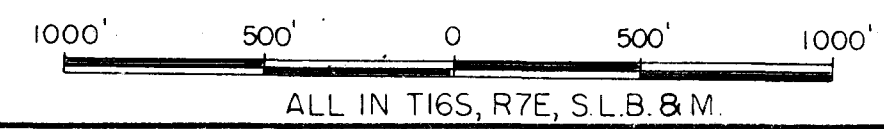
SECTION 6 SECTION 5



- A Strong possibility of visual subsidence 12° positive break line.
- B Moderate possibility of subsidence
- C Moderate to light possibility of subsidence.
- D NO SUBSIDENCE EXPECTED OUTSIDE OF PERMIT AREA.

— LEGEND —

- SUBSIDENCE MONITORING MONUMENT — (circle with dot)
- OUTCROP HIAWATHA SEAM — (wavy line)
- OVERBURDEN THICKNESS CONTOUR — 400 —



TYPICAL MONUMENT

GENWAL COAL COMPANY, INC.

SCALE 1" = 500'	APPROVED BY D. A. S.	DRAWN BY I. L.
DATE 8-29-81	OVERBURDEN and PERMIT BOUNDARY	
COAL SYSTEMS, INC.	DRAWING NUMBER 4047-4	